[redacted] [redacted] 25X1

November 25, 1966

Subject: [redacted] Proposal 9499-0003 25X1

Attachments: Introduction
System Description
Discussion of Specifications
Proposed Equipment
Price and Delivery, Terms and Conditions
VR-2000 Data
Data on a Slow Motion Television Recorder
[redacted] Video Communications Systems 25X1

Gentlemen:

[redacted] is pleased to submit this proposal in response to your request for a Magnetic Tape to Photo Reproducer, dated 8 September 1966. 25X1

Information contained in this proposal relative to the disc recorder is considered proprietary with [redacted] and should not be duplicated, used or disclosed in whole or in part for any purpose other than to evaluate the proposal. 25X1

The proposal consists of this letter and the above referenced attachments. If you have any questions or require any further information, please do not hesitate to contact us. For most expeditious service, please contact our local field representative in your area, [redacted] 25X1
[redacted] 25X1

Very truly yours,

[redacted] 25X1

[redacted] Manager 25X1
Product Management Department
Audio/Video Communications Division

LW:ms

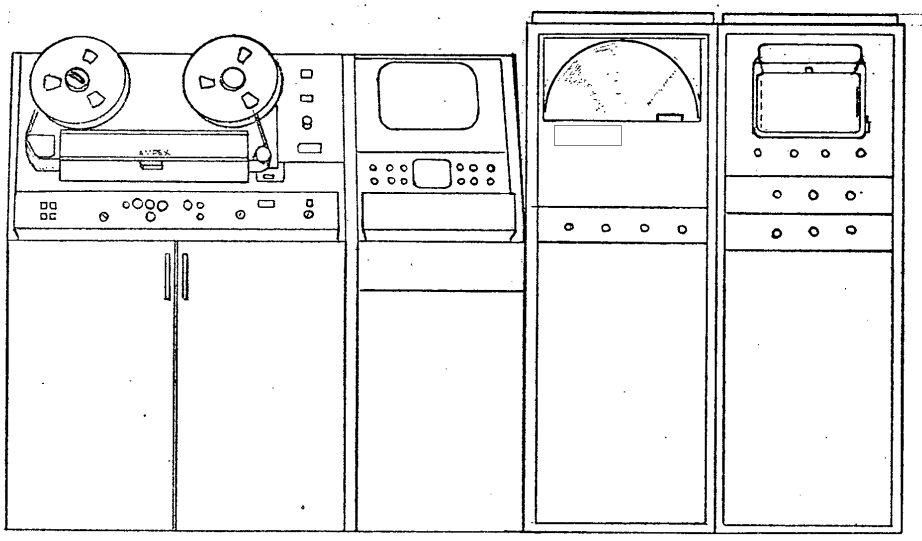
[redacted] 25X1

INTRODUCTION

The Magnetic Tape to Photo Reproducer system which is the subject of this proposal provides the capability of production of highest quality photographic images from selected portions of quadruplex-type Videotape recorded in any of the international recording standards. The system includes an [redacted] VR-2000 for Videotape play back with plug-in interchangeability for all international tape standards. In order to provide short term picture storage capability for selection of the desired frame to be photographed, a high resolution [redacted] Video Disc Recorder is furnished. The output of the disc recorder drives a high resolution, flat-faced kinescope type monitor complemented by a group of image enhancement controls. The final link in the chain is a large negative camera (4 x 5) capable of producing high resolution negatives with standard-type sheet or pack films or quick development positives with Polaroid-type emulsions. The indivdual components will be combined and engineered to operate as in integrated system with a maxiumum degree of maintainability and flexibility. Special precautions will be taken to contain video signals within the equipment to prevent interference with other electronic devices in the immediate vicinity of the reproduce system.

25X1

25X1



25X1

25X1

MAGNETIC TAPE-TO-PHOTO
REPRODUCER

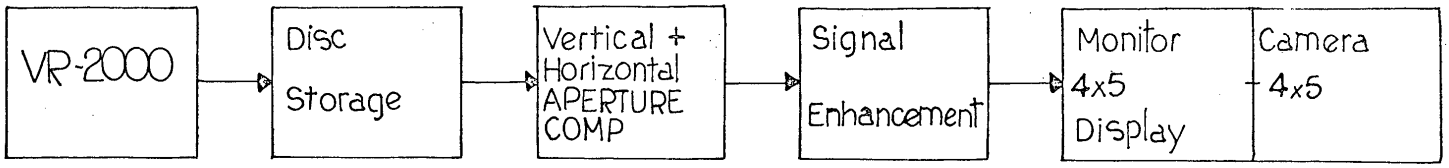
SYSTEM DESCRIPTION

1.0 The video tape to photograph conversion system which is the subject of this proposal is shown in block diagram form in Figure 1. It consists of a VR-2000 video tape recorder/reproducer, a magnetic disc recorder/reproducer for short term storage of the video image, a high resolution monitor with signal enhancement capabilities and a still camera. The system is designed to accept tapes made in any of the world line and frame rate standards in common use and convert them to high resolution still photographs. The following description covers the various components of the system.

1.1 Video Tape Recorder/ Reproducer

In 1956 [redacted] introduced the video tape recorder. This device was the first to allow recording of standard 525 line 60 field black and white U.S. television signals on other than photographic film. The quality, re-useability and ease of editing and program assembly of the magnetic tape recording method then made the tape recorder the standard signal storage medium for the television industry. The VR-1000 equipment as that recorder was called subsequently achieved worldwide acceptance and was necessarily provided with capabilities for recording other broadcasting line and field rate standards. 25X1

With the advent of color television and the need for higher signal quality brought about the the 625 line European television standards, in the past few years it has proven desirable to achieve a measure of performance improvement which was simply not available on the VR-1000 with its deviation standards, yet it was necessary to maintain compatibility with all previous recording systems. The result of and answer to this need was the introduction by [redacted] of the VR-2000 in 1965. This recorder through the use of superior signal electronics and heads, was able to raise the FM deviation frequencies sufficiently to allow vastly improved 25X1



Video Playback
525/60
625/50
405/50 plug-ins
819/50

Frame or Field Hold
50 or 60 Frame Speed

Non-Linear Amplification

2x1 Magnification
Spot Wobble

Sheet Film
Ground Glass
Polaroid

FIGURE 1

VIDEO SYSTEM BLOCK DIAGRAM

signal integrity, frequency response and freedom from spurious signal products. In addition, the capability was maintained to play back any tapes recorded on the previous "low band" deviation standards.

The VR-2000 included in this system provides the maximum playback performance for any tape, regardless of the source of the original recording. Playback plug-in filters and deviation selectors are provided signal standards of 525/60, 625/50, 405/50 and 819/50 with both high and low band recording options as applicable. The equipment performance will be as given on the enclosed specification sheet.

1.2 Video Disc Slow Motion Recorder

In order to provide short term storage for frame examination and selection, and advanced design video storage disc assembly is proposed. This unit will accept and record video data without degradation in any of the line and frame rate standards mentiolned. The last 30 seconds of playback are stored in the disc buffer, and when the recording process is terminated, these stored images may be examined a frame at a time in slow or stop motion to select the most suitable one for photography. When the desired frame of field is found, it is held by the disc for adjustment of the monitor and the final photography.

Previous disc recording assemblies available did not provide the bandwidth or signal integrity needed in this application for best picture reproduction. Their frequency response performance was limited to below 4 MHz and the time base stability of the reproduced frame was insufficient for high resolution presentation without image degradation. There was also no provision for operation at 50 field per second rates required for foreign TV standards. The [redacted] disc proposed provides signal integrity and quality sufficient to record color as well as black and white signals with a quality which compliments that obtained with the VR-2000. The disc system is further described in the attached material entitled "Data on a Slow Motion Television Recorder". 25X1

1.3 Aperture Compensators

In order to provide the best possible image which may be obtained from the incoming video, it is often possible to increase the apparent definition of the image by boosting the high frequency response of the data. This process gives better definition to the edges of the image at the expense of some high frequency noise addition. If enough range is available in the aperture correcture correctors, the image may appear to be outlined and this may make possible the identification of shapes which were not easily perceived in the unprocessed picture.

Horizontal aperture correctors have been used to a great extent in commercial television systems to compensate for the transmission losses within a studio camera chain and achieve an overall flat response. The techniques for accomplishing horizontal aperture correction and the results obtained are well known.

Experimental evidence has shown that the enhancement effect obtained by vertical aperture correction is at least as great as that which may be obtained in the horizontal direction. Only recently has the availability of high quality one line delay lines and reliability of solid state circuitry made it possible to impliment a vertical aperture correction system.

Figure 2 shows a simplified block diagram of a combined horizontal and vertical aperture corrector. The input signal is called V(t), the one line delayed signal $V(t-t_1)$ and the two line delayed signal $V(t-2t_1)$. For vertical correction t_1 must be equal to the line scan time which must be a switchable value to correspond to the various line standards required for this system. The vertical correction signal $V(t-t_1) - 1/2V(t) - 1/2V(t-2t_1)$ is added to the one time delayed signal $V(t-t_1)$. The amount of the first signal added to the one line delayed signal determines the amount of edge enhancement obtained.

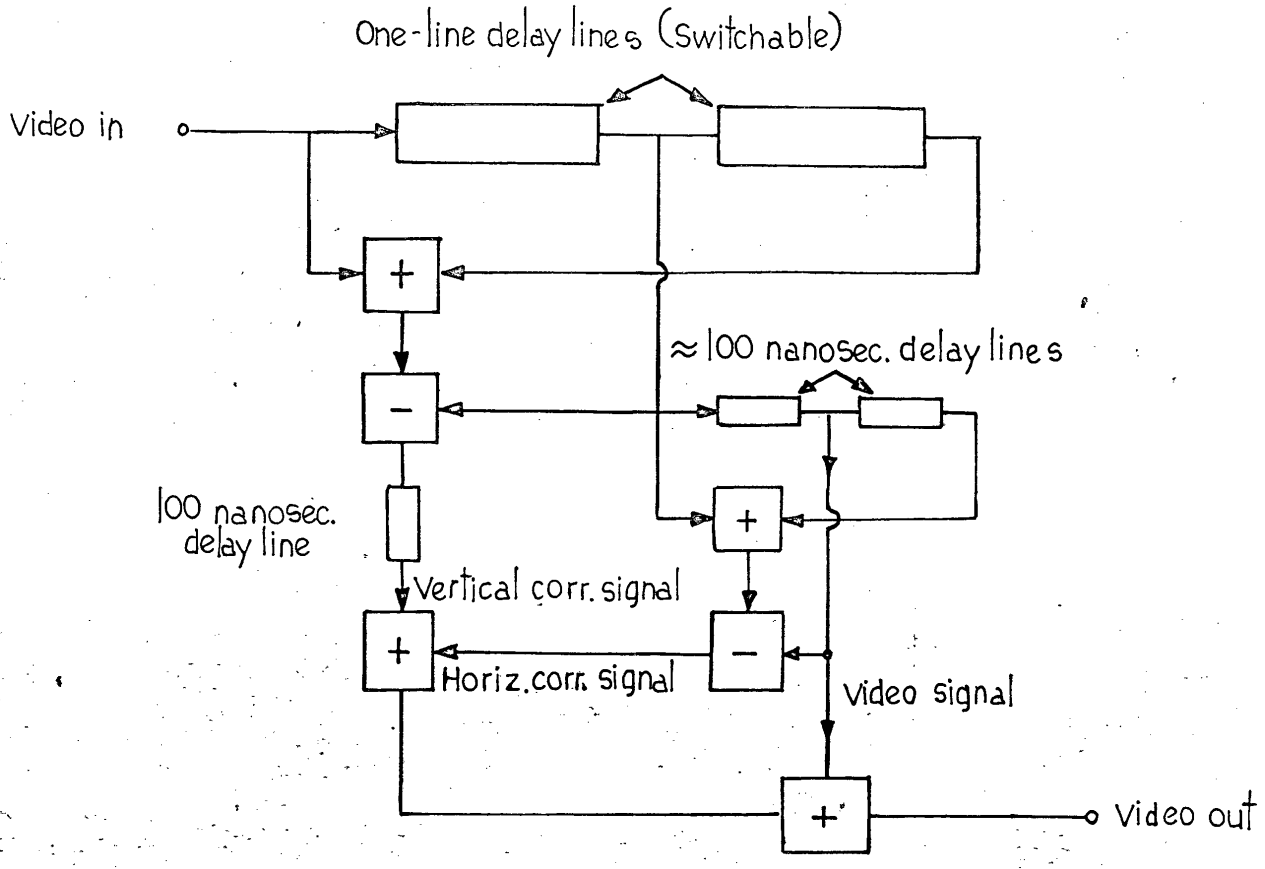


FIG. 2 SIMPLIFIED BLOCK DIAGRAM OF COMBINED HORIZONTAL AND VERTICAL APERTURE CORRECTOR

Horizontal aperture correction is obtained through the processing of the one line delayed signal $V(t-t_1)$ which is now the reference signal. The horizontal corrector uses delay lines approximately the length of a picture element (100 nsec). The horizontal correction signal is then equal to $V(t-t_1-t_r) - 1/2V(t-t_1) - 1/2V(t-t_1-2t_r)$. The amount of this signal injected determines the degree of correction.

It can be readily seen that in both of the above systems that the delayed signals are inverted and mixed with the original signal. Low frequency signals which are identical in the delayed and undelayed channels are cancelled by the phase inversion while high frequency signals come through undiminished. The process is a linear one as the cancellation process is one of both phase and amplitude, but the net effect is high frequency boost without differential phase shift of the various video frequencies.

1.4 Other Signal Enhancement

As additional features to allow maximum enhancement of the video signal prior to photography, an equalizer bay is included with the system with the capabilities for non-linear amplification of the video signal. This bay provides a selection of linearity curves which allows expansion of the near-black or near-white area to allow contrast improvement of marginal signals. This is the type of processing called "black stretch" or "white stretch". The controls can be adjusted to produce logarithmic and exponential amplification curves as well as amplification of signals which are above or below a given threshold.

1.5 Monitor

One of the most critical elements of the system and the limiting one if attainable output resolution is the output monitor. The monitor chosen for this system represents the best device obtainable commensurate with the switchable standard requirements. Spot wobble is not included to

reduce the visibility of the line pattern on the screen as it would interfere with the definition of the picture during the primary reduction mode which is envisioned to be 625 lines.

Due to phospher noise and light scattering from the tube faceplate, even though the spot size of the monitor is theretically small enough to reproduce all the detail inherent in the video signal, in practice there is a small loss in resolution. In the event this loss is unacceptable, the monitor is provided with the capability of increasing the vertical and horizontal sweep width to provide a 2/1 electronic magnification. This overscan then allows the video signal to become the resolution limit rather than the spot size and light scattering properties of the monitor faceplate.

1.6 Camera

The camera utilized for this sytem is a standard type designed for photography of oscilloscopes and other such displays. The camera utilizes a standard Graflok back which allows the quick interchange of ground glass for fine focusing and both sheet film and Polaroid type backs depending on the type of film stock desired. Due to the use of the disc recorder, longer exposures can be utilized than would normally be available for single frame photography, thus, allowing the use of higher F stops in the camera with a consequent increase in the available resolution of the lens. The longer exposure time also allows some integration of the electronic noise of the system over the period of the photograph.

1.7 Initial Operation of System

In order to assure optimum operation of the system from the time of initial installation, [redacted] will provide a contract service engineer who originally participated in the video system integration. This man will be one of the elite group of [redacted] service engineers who keep [redacted] equipment in top operating condition in all applications throughout the world. He will assist in the equipment operation during the first year of operation and train

25X1

25X1

customer personnel in operation and maintenance of the system as well as methods of attaining optimum signal enhancement. The engineer will be cleared to the necessary level for access to the operating facilities.

DISCUSSION OF SPECIFICATIONS

General Configuration

As stated in the description of equipment, the basic Video Recorder/Reproducer chosen for this system is the [redacted] Model VR-2000. This equipment is furnished with switching and plug-in modules for tape recorded on standards of 525/60, 625/50, 405/50, and 819/50 standards. The VR-2000 is now the standard for world-wide color recording and as such has unequaled capacity for subsequent updating to full color capability. It is only necessary to add the [redacted] modules to the VR-2000 to achieve a fully color compatible recorder/reproducer.

25X1

25X1

Stop Motion

The high quality disc-type recorder described in the attached information will be furnished for a temporary storage and frame-by-frame examination required. This recorder in its electronics section utilizes approximately the same electronics as the VR-2000 recorder and as such has the same capability for subsequent updating to color. To our knowledge, it is the only disc unit available with sufficient signal integrity and capability to allow color playback of NTSC-type color signals. The disc recorder is provided with a capability of frame or field single hold output as well as frame-by-frame or slow motion advance.

Display

A kinescope-type flat-faced monitor described in the attached information will present the imagery for photographing. This device will include the usual contrast and brightness controls as well as standard switching and electronic magnification controls.

* [redacted]

25X1

Photography

The camera provided for this system, as previously described, will incorporate a 4 x 5 in. frame size for recording the CRT image. A fine focus control will be external to the camera and focusing will be done in relation to a ground glass or split image focusing plate provided. An exposure meter will be provided for exposure adjustment and setting of the camera. The camera has a standard Graflok back with adjustable positions and will be provided with both a cut and sheet film holder and a Polaroid-type film back.

Integration

Construction and integration of the system will be accomplished by the Special Products Department of [redacted]. This group is experienced in the construction of video-type systems and has produced some of the best mobile and stationary studio-type video recording and transmitting equipment installations in use today. Typical of the quality and type of equipment produced is the first mobile color van recently delivered to a Texas broadcasting station. This van is in continuous use for color telecasting of such programs as football games. It provides the total capability of a television station on wheels and was well accepted by the station involved in respect to the human engineering factors of the mobile system. This station was placed on the air within one day after its arrival in Texas from [redacted] and has been in almost continuous operation ever since with no maintenance or necessity for design changes for operator convenience. In the Special Products Department, [redacted] provides to the customer the services of a unique group of user oriented people capable of integration of such a system. The attached brochure describes more of the capabilities of this department.

25X1

25X1

25X1

Image Enhancement

All image enhancement techniques referenced in the system description will be provided. These include vertical and horizontal aperture equalization, black and white stretch or variable linearity amplification and electronic magnification controls on the monitor.

Radio Frequency Interference

Special attention will be given during the interface design of the system for suppression of radio frequency interference. In this regard, most attention will be paid to the disc recorder as this is envisioned to be the primary source of intelligence interference. This is due to the fact that the disc unit must record as well as reproduce signals which involves a much higher power level of the video intelligence than the video reproducer. It is envisioned that the final system will be subjected to an emission test as referenced in Federal Standard 222. The results of this emission test will be furnished to determine if additional shielding such as an overall screen room will be required for the system or if the system will be acceptable without additional shielding. If it is found that, despite precautions in the equipment design, additional shielding is necessary to meet the customer's requirements, the actual shielding and/or screen room construction will be negotiated separately.

Physical and Operational Considerations

The only facilities necessary for the operation of this equipment will be 110 volt single phase power. All other supplies will be internal in the equipment.

Size

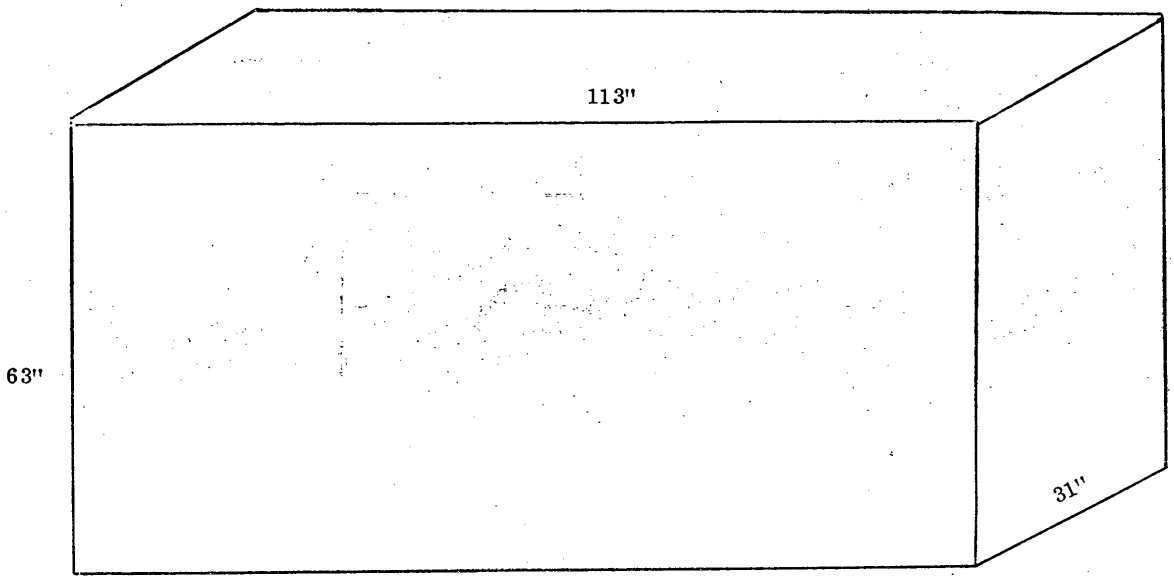
The maximum size of any component of the equipment will be that of the VR-2000 recorder itself. This device has a height of 63 inches, and width of 65 inches and a depth of 31 inches. Its maximum weight is 1300 pounds. All other units will be considerably smaller than the video recorder.

Safety Hazards

The equipment proposed herein is designed for the television broadcasting industry in general. As such special considerations are taken for operator's safety and many interlocks and guards are provided to prevent contact with the high voltage and high power circuitry.

Installation Instructions

The attached block diagram and dimensions indicate the space required for installation of the equipment. Basically the space required consists of five standard relay rack widths and depths.



Front View

Figure 3. Outline Dimensions
Video System

PROPOSED EQUIPMENT

The [redacted] Magnetic Tape to Photo Reproducer System will consist of the following integrated set of components: 25X1

Quantity	Description
1	[redacted] Model VR-2000 V deotape Recorder/Reproducer High/Low Band to include: 25X1 One (1) Cabinet assembly containing tape transport and all electronics One (1) Tape Timer One (1) "A" Scope Monitor One (1) Air Bearing Kit One (1) 12-1/2 inch Takeup One (1) Alignment Tape Two (2) Instruction Manuals One (1) Micrometer Dial Indicator One (1) Head Demagnetizer One (1) Set Hex Key Wrenches One (1) Touch-up Paint Kit One (1) A . C. Power Cable One (1) Audio Cue Channel
2	Mark Ten Video Head Assemblies
1	Monitor Assembly
6	Deviations standards modules for the following standards: 525/60 High and low band 625/50 High and low band 819/50 High band 405/50 Low band Plus associated low pass filters and equalizers

Quantity	Description
1	[redacted] Slow Motion Video Disc storage system for operation at both 50 and 60 fields per second. Internal recording will be done with 625/50 High Band standard deviations with low pass filters switched in for optimum performance at 405 and 525 line standards.
1	Vertical aperture compensator for 405, 525, 625 and 819 line operation.
1	Video signal processing module incorporating: a. Choice of four gamma laws b. Horizontal aperture correction with the choice of two cutoff frequencies
1	Flat face kinescope type monitor for operation at standards of 405/50, 525/60, 625/50 and 819/50. Monitor will include contrast and brightness controls as well as standard switching and electronic magnification controls over a 2 x 1 range.
1	Camera Assembly with 4 x 5 film size including ground glass or split screen focussing, 4 x 5 sheet film and film pack back plus Polaroid adapter back.
1	Exposure meter.

25X1

25X1

NO. 9499-0003

PROPOSAL

PRICE AND DELIVERY, TERMS AND CONDITIONS

[redacted] is pleased to quote the following fixed prices on the [redacted] Magnetic Tape to Photograph Reproduction System. 25X1

The price quoted is based on the integration of previously developed components into an operational system. Accordingly the cost-type progress reports requested in the technical specification will not be furnished. This type reporting is applicable only to a Research and Development type contract. In lieu of these reports, a technical type progress report will be submitted on a monthly basis.

Item 1. One (1) [redacted] Magnetic Tape to Photo Reproducer System as described in the attached technical proposal. 25X1

Unit Price ..... [redacted] 25X1

Delivery of this system can be accomplished 6 months after receipt of firm purchase order by [redacted] or February 1968 whichever is later. 25X1

The testing of the Magnetic Tape to Photo Reproducer System to the requirements of FED STD. 222 is considered of indeterminate value in this circumstance due to the type signal produced by the video recorder. For this reason, we have chosen to include the cost of testing to this specification as an optional extra. We would be pleased to discuss this problem further with your technical representatives at a later date.

Item 2 Testing of the completed Magnetic Tape to Photo Reproducer System to FED SPEC. 222. This item only covers testing the equipment. Any modifications determined to be necessary after the test performance will be the subject of separate negotiations.

THIS PROPOSAL AND THE PRICES QUOTED HEREIN ARE BASED UPON THE UNDERSTANDING THAT [redacted] STANDARD TERMS AND CONDITIONS OF SALE, APPEARING ON THE REVERSE SIDE HEREOF, SHALL BE APPLICABLE TO ANY SALE, AND THAT YOUR ORDER SHALL BE RECEIVED BY [redacted] NO LATER THAN THIRTY (30) DAYS FROM THE DATE HEREOF. YOUR ACCEPTANCE OF THIS PROPOSAL ON THE TERMS HEREIN STATED SHALL BE INDICATED BY OUR RECEIPT OF YOUR ORDER. 25X1 25X1

UC-428

25X1

NO. 9499-0003

PROPOSAL

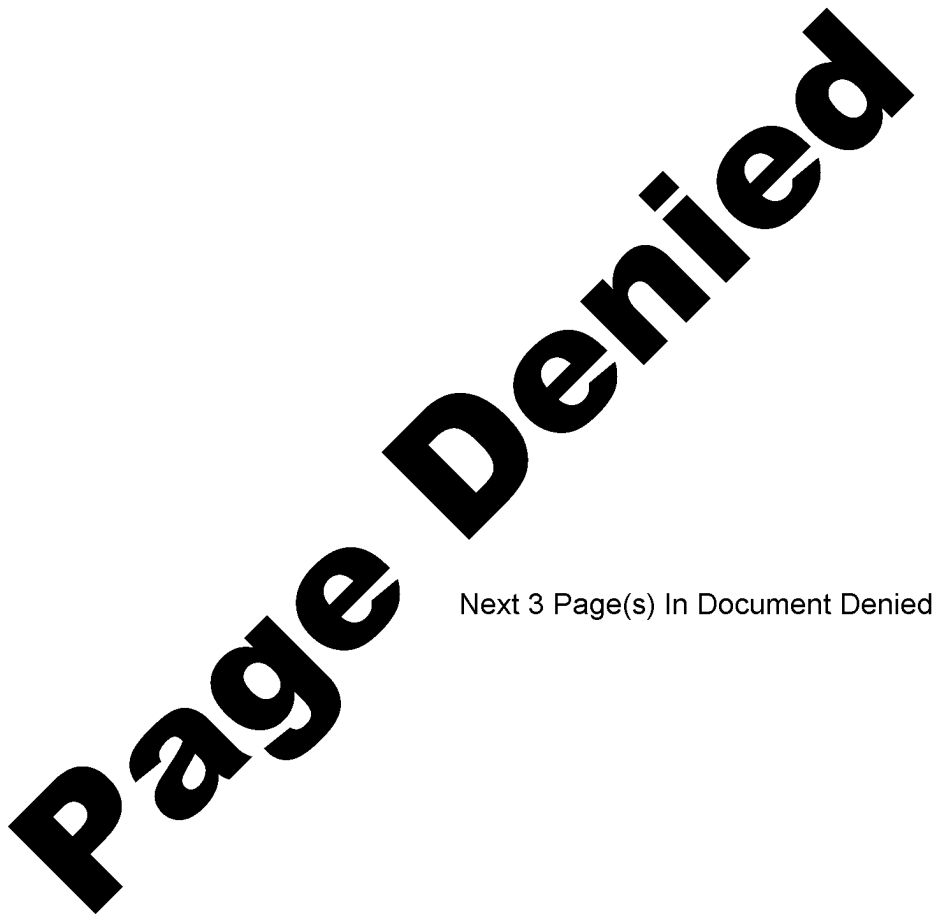
Unit Price 25X1

This testing can be completed 30 days after system assembly.

This proposal is submitted on the basis of Standard Contractual 25X1
Terms and Conditions indicated on the reverse side of this letter. The prices quoted herein are based on the understanding that your order will be received by no later than sixty (60) days from the date of this 25X1
proposal. If an extension is required, please contact your local sales office.

THIS PROPOSAL AND THE PRICES QUOTED HEREIN ARE BASED UPON THE UNDERSTANDING THAT STANDARD TERMS AND CONDITIONS OF SALE, APPEARING ON THE REVERSE SIDE HEREOF, SHALL BE APPLICABLE TO ANY SALE, AND THAT YOUR ORDER SHALL BE RECEIVED BY NO LATER THAN THIRTY (30) DAYS FROM THE DATE HEREOF. YOUR ACCEPTANCE OF THIS PROPOSAL ON THE TERMS HEREIN STATED SHALL BE INDICATED BY OUR RECEIPT OF YOUR ORDER. 25X1 25X1

UC-425



Next 3 Page(s) In Document Denied

DATA ON A SLOW MOTION TELEVISION RECORDER

1.0 INTRODUCTION

The equipment described herein will record standard television signals and reproduce them either at the standard rate or in stop motion or slow motion. By means of a continuous updating process, the previous 30 seconds of program is always available for replay unless interrupted by periods of playback.

The equipment is designed for either studio or mobile use and may be operated from a small remote control panel. This allows the rack mounted recorder to be located where convenient in the studio or vehicle.

2.0 EQUIPMENT DESCRIPTION

2.1 GENERAL DESCRIPTION

The recorder comprises a number of units designed for mounting in a standard 19-inch rack. A local monitor is furnished to display the frame of field being observed. The equipment records only video signals and is designed to operate from 115V, 60 cps power. Controls are provided for playing back slow or stop motion and for searching the previously recorded video. When the desired action has been located, the picture is held in stop motion for photography.

2.2 THE DISC TRANSPORT

2.2.1 Disc Drive. This consists basically of two 16-inch diameter discs mounted on a common shaft which is rotated at 3600 RPM (3000 RPM for 50 field data). The discs, which are about 1/4 inch thick, are highly polished and plated with nickel-cobalt. The process is carefully controlled to produce

the desired coercivity in the magnetic material and, to reduce head separation losses, has a surface finish better than 6 microinches peak-to-peak. A final "flash" coating of Rhodium prevents tarnishing and improves the durability of the surface.

The disc and shaft assembly is driven by a printed circuit DC motor operating in conjunction with the Motor Drive Amplifier and Servo system.

The disc transport is contained in a dust-proof housing since it is essential to keep the disc surfaces free from dirt.

Both sides of each disc are used to obtain a storage capacity of 450 TV fields per side, using a maximum radius of 8 inches and a minimum radius of 3-1/2 inches. The principle used is to select a minimum writing speed adequate for the bandwidth desired. This controls the choice of minimum radius. Writing speeds in excess of this minimum are encountered nearer the disc periphery but, since the shortest recorded wavelength is long compared with the gap length of the video head, the changes in playback frequency response are not excessive. Compensation for these changes in response will be discussed under 2.11.

2.2.2 Head Carriage. Four (4) Head Carriages are required, one for each side of both discs. The assembly consists of a stepping motor with a spring-loaded split pinion gear. This works in conjunction with a rack sliding in a groove. A small video head assembly is mounted on the end of the rack and is spring-loaded on the disc surface. Pressure between the head and the disc is adjusted to no more than 3 grams so that friction between the highly polished disc and head tip is negligible. The rack has 450 teeth so that the head may be positioned to record or play back any one of 450 concentric tracks.

2.2.3 Carriage MDA (Motor Drive Amplifier). In order to move the head carriage, pulses are applied to the stepping motor via the Carriage MDA. Time taken for the head to move to an adjacent rack is about 16 milliseconds.

2.2.4 RAPA (Record Amplifier and Preamplifier). A RAPA is mounted adjacent to each video head, keeping the flexible connecting lead as short as possible. Capacity is not a problem due to the low impedance of the head and its input circuit.

2.2.5 Once Around Tachometer. This consists of a photo-diode and lamp. There is a black mark on the disc at the appropriate point for the timing reference.

2.2.6 High Resolution Tachometer. A photo-etched disc is used, having 3012 segments, together with a lamp and photo-diode.

2.3 RECORDING THE VIDEO SIGNAL

2.3.1 The FM Signal System. The FM Signal System is of new design very similar to that used on the [redacted] VR-2000 Video Recorder. It uses the same high band standards in order to eliminate the second order FM sidebands. Consequently the system is very suitable for recording color signals having a subcarrier which might otherwise cause moire patterning effects. 25X1

The modulator, demodulator, record amplifier and switcher are designed for a 6 MHz video bandwidth including the head-to-disc recording process. With 525 line operation and the bandwidth restricted to 4.2 MHz, a larger deviation may be used without causing the upper sideband to fall outside the equalized RF bandwidth which normally extends out to 14 MHz. For this reason signal-to-noise ratio is about 3 db better with the 525 line system than with 6 MHz 625 line system.

It is not within the scope of this proposal to describe the signal system in any detail since the units are almost identical to those used on all [redacted] Videotape recorders of recent design. 25X1

2.3.2 Recorded Format. There are four disc sides available for recording and four head carriage assemblies. In the record mode the action of these head carriages is as follows:

Suppose we designate the disc sides 1, 2, 3 and 4. The first incoming TV field is recorded on Disc 1 by Head 1; the second incoming TV field is recorded on Disc 2 by Head 2. This completes the recording of Frame No. 1.

The third incoming field is recorded on Disc 3 by Head 3; the fourth incoming field is recorded in Disc 4 by Head 4. This completes Frame 2.

In each case, immediately following the recording of a field, the carriage stepping motor receives two pulses causing two indexing movements, thereby leaving a space for interlacing another track when the head finally returns from the innermost limit of its travel. Thus, approximately 30 milliseconds after recording a field any one head is indexed to a new track and ready for the next recording. The recording sequency proceeds as follows:

Field 5 is recorded on Disc 1, Track 2	Frame 3
Field 6 is recorded on Disc 2, Track 2	
Field 7 is recorded on Disc 3, Track 2	Frame 4
Field 8 is recorded on Disc 4, Track 2	

This reciprocating motion continues until each disc has 225 fields recorded per side.

This corresponds to the innermost limit of travel on the disc.

The first movement of a head back toward the periphery is only one track width (plus guard band). The succeeding movement is a double track width. This sequence results in an interlacing of the recorded tracks.

The head finally reaches the outermost track and reverses direction making only one track width movement, followed by two movements. It will now be writing over the first fields previously recorded.

Thus, in the way described above we have continuous updating of the recorded picture. For an equipment of the capacity described, this means that the last 30 seconds of recorded information is always available.

2.4 PLAYBACK AT NORMAL SPEED

For playback at normal speed the head movements are exactly the same as for the recording mode. The heads are, of course, now connected to a preamplifier for playback into the demodulator.

2.5 STOP MOTION

For stop motion, the preamplifier and demodulator remain connected to a single head, the single field being repeated for as long as required. The processing of these fields into EIA interlaced signals is discussed under 2.8.

2.6 SLOW MOTION

Slow motion is achieved by extending the principle of stop motion. Field 1 is repeated five times in the proposed equipment. This is followed by Field 2 which is repeated five times and so on. This results in a slow-

down in the playback of 5 to 1 so that the origian 30 seconds of recording will be played back over a 2-1/2 minute period.

Thus, the system described, by repeating fields rather than frames, produces the best possible slow motion from a TV system. In reconstituting the picture into frames, there is a loss in vertical resolution which is barely perceptible under normal viewing conditions. Moreover, there is a considerable improvement in overall sharpness due to reduced movement blur. As a typical example, consider the taking camera is an Image Orthicon type operating one stop above the "knee". The exposure time, or the time taken for the target to reach 90% of its 2-volt potential is less than $\frac{1}{60}$ second for wide spaced types such as the 5820. Thus, each field is sharply defined and should not be played back on the basis of repeating frames which will result in double images of fast-moving objects.

In the case of non-moving subjects, better definition may be obtained in a stop-frame mode. In this case, the equipment is provided with the stop frame rather than stop field display, depending on a switch position.

2.7 ARTIFICIAL INTERLACE

Successive playing of a single field results in a non-interlaced picture. This problem is easily resolved by means of a half-line video delay. The principle used is to play back the vertical sync undelayed, but to switch the video of alternate fields through the one-half line delay.

The glass delay line is well suited to this application. Since the signal is already in FM form as it leaves the channel equalizers, it can be heterodyned up to at least 60 MHz,passed through the delay line and heterodyned down again. In this way, the delay line behaves like a wide bandwidth IF amplifier.

2.8 LOGIC CIRCUITS

The record and playback switchers require suitable logic signals for the selection of heads or amplifiers at the correct moment in time in order to achieve the Record, Stop Motion and Slow Motion sequences described. Logic is also required for the head carriages to correctly time the indexing movements. The proposed design makes use of the next types of integrated circuit logic wherever possible, in the interests of reliability and circuit simplicity.

2.9 SERVO SYSTEM

The disc assembly is driven by a printed circuit type DC motor.

The operating sequence from standstill is as follows:

1. The DC motor, driven by a DC Motor Drive Amplifier, brings the disc assembly up to synchronous speed.

2. As the disc rotates, pulses from the Once Around Tachometer are compared with the incoming vertical sync pulses in a digital comparator. The difference signals are fed through compensating networks into the MDA which applies the necessary correction to the motor until the vertical sync and tachometer pulses are coincident.

3. The high resolution tachometer provides 3012 pulses per resolution to a damping loop which reduces disc hunting.

4. When conditions have stabilized, the incoming horizontal sync pulaes are compared with the horizontal sync pulses played back off the disc until the required phase lock is achieved.

5. Remaining time base errors now fall within the correction range of the AMTEC delay lines, so that pictures off the disc can be super-imposed on pictures from other sources operating from the same Sync Generator.

2.10 RADIUS COMPENSATION

A problem peculiar to the use of discs is the need for radius compensation. In order to achieve the longest possible playing time it is necessary to tolerate a considerable change in writing speed and make corrections for the resultant changes in frequency response.

In the system proposed the maximum writing speed is 3000 inches per second, at a radius of 8 inches. With 450 tracks at 100 per inch, the inside radius is 3.5 inches with a writing speed of 1320 ips.

The response of the channel equalizers is variable by means of an applied voltage. It is, therefore, possible to apply an approximate correction for the radius change from a potentiometer on the head carriage assembly.

2.11 REMOTE CONTROL PANEL

The following controls are located on the remote control panel, and their function is self explanatory.

Record-Start
Record-Stop
Playback Normal Speed
Playback Slow Motion
Playback Stop Motion
Fast Search, Forward and Reverse
Rest to Zero

In addition, an Elapsed Seconds indicator is servo-coupled to the position of #1 Head Carriage. Thus, in addition to operating as a seconds counter at normal speeds, the indicator will accurately follow the movement of the head carriage on slow motion or fast search.

3.0 SPECIFICATIONS

3.1 Physical Characteristics

Dimensions

Height: 61 inches
Weight: 800 lbs. maximum
Width: 24 inches
Depth: 28 inches

Temperature and Humidity

Temperature: 0^{o} to 55^{o} C
Relative Humidity: 30% to 90%

Power Requirements

Input Power: 117 volts $\pm$ 10%, tapped for 105-115-125 volts, 60 cycle, 30 amps (will regulate and operate without changing taps from 105-125 volts)

or

230 volts $\pm$ 5%, tapped for 210-220-230-240-250 volts, 50 cycle, 15 amps.

Convenience Outlet: 4 outlets fused for 16A total

Signal Requirements

Video Composite Signal: 0.5 to 1.5 volts peak-to-peak composite, sync negative.

525 Line Monochrome
525 Line NTSC Color
625 Line PAL Color
75 ohm unbalanced

405 Line Monochrome
819 Line Monochrome or SECAM
625 Line SECAM Color

Sync Input: 75 ohms, 2 to 8 volt peak-to-peak

3.2 Operating Characteristics

Record Time: 30 seconds
Playback Time: 2-1/2 minutes (5/1 slow motion)

Continuous Updating

The last 30 seconds available except when interrupted for playback

Fast Search Facilities

Required action for playback can be found by remote control, aided by a seconds counter.

Stop Motion

Single frames can be played continuously.

Animation Rate

When playing 5/1 slow motion, each field is repeated 5 times with artificial interlace. The animation rate is then 12 per second.

Stability

Jitter (Inter-sync playback), i.e., timing variations with respect to reference sync occurring at rates greater than 1 cps excluding video

field rate multiples less than 0.5 usec peak-to- peak with AMTEC off.

3.3 Standards

The recorder is supplied for all standard operation. It will utilize 625 line High Band Standards for all internal recording with switchable low pass filters to optimize signal-to-noise ratio in 405 and 525 line operation.

3.4 Monitoring Facilities

Video: A video monitor and a Tektronix waveform monitor are available.

3.5 Accessory Equipment Needed for Color Operation

1. AMTEC
2. COLORTEC

3.6 Video Performance	525/60 High Band
MONOCHROME	
Bandwidth:	4.5 MHz - 3 db
Response will be within ± 1 db of these values referenced to 100 kc	
Signal-to-Noise Ratio:	40 db peak-to-peak video to rms noise(Monochrome and Color)
Transient Response: (Utilizing 2T $\sin^2$ pulse)	Maximum K factor 3%
Low Frequency Linearity:	2% Blanking to White (Max.)
Rise Time: (.02 μ sec or less rise time on input pulse)	0.12 μ/sec. maximum

COLOR	
Bandwidth:	
with NTSC input, Luminance	2.5 MHz - 3 db
Signal-to-Noise Ratio:	40 db peak-to-peak video to rms noise
Differential Gain	Less than 4% Blanking to White
Differential Phase:	Less than 5^{o} at 3.58 MHz off disc
Moire:	
(Color bars 75% modulation, 3.58 MHz)	37 db maximum
Video (International)	625/50 High Band
MONOCHROME	
Bandwidth:	6.0 MHz - 3 db
Response will be within $\pm$ 1 db of these values referenced to 100 kc	
Signal-to-Noise Ratio:	40 db peak-to-peak video to rms noise (Monochrome & Color)
Transient Response: (Utilizing 2T $\sin^2$ pulse)	Maximum K factor 3%
Low Frequency Linearity:	2% Blanking to White(Max.)
Rise Time: (0.02 μsec or less rise time on input pulse)	0.08 μsec maximum

Video 405 lines 50 field (Monochrome)
Performance Specs. for 625/50.
819 lines 50 field (Monochrome or SECAM Color)
Performance Specs. as for 625/50.